Experimental and Field Studies to Assess Pulsed, Water-flow Impacts on the Behavior and Distribution of Fishes in California Rivers

Contract #: 500-01-044
Contractor: University of California, Davis
Contract Amount: $1,987,000 (Full contract amount; only part funded this project.)
Contractor Project Manager: A. Peter Klimley, Joseph J. Cech, Jr., and Lisa C. Thompson
Commission Project Manager: Joe O'Hagan
Commission Contract Manager: Joe O'Hagan

The Issue

Hydropower provides anywhere from 9 percent to 19 percent of California's electricity annually. This percentage varies each year, and is dependant on water availability and other factors. Dam operators release increased water flow (pulses) in California rivers not only to generate electricity, but also to control flooding and to facilitate recreational river rafting. These pulsed flows can affect the distribution of native stream species because the increased frequency of these flows and their late, warm-season timing deviate significantly from the stream's natural seasonal flow, or *hydrograph.*

Project Description

As part of the Pulsed Flow Program, the California Energy Commission's Public Interest Energy Research (PIER) Program funded research at the University of California, Davis, to conduct experimental and field studies to assess the impact of pulsed flows on four species of fishes (rainbow trout, brown trout, hardhead minnows, and Sacramento suckers) that inhabit Californian rivers.

Researchers implanted radio beacons in all four fish species. The rainbow and brown trout were tracked during a single pulsed flow in the Silver Creek reach of the American River. Fish numbers were recorded in pools along this reach during snorkel surveys before and after the pulsed flow. Researchers recorded the responses of rainbow trout, hardhead minnows, and Sacramento suckers to artificially pulsed flows within a longitudinal flume, in which were placed rocks to simulate the bottom of the mainstem of the American River. The movements of individuals of these species were also determined in a lateral displacement flume, consisting of a rectangular tank separated into a main channel that never drained and a raised wide channel that alternately flooded and became exposed. Water circulated through the apparatus, flowing downward over a slope into a series of channels and potential fish holding areas. Four pools existed on the raised wide channel with different shapes, holding, and draining capacities. Fish could become stranded in one of these pools as the water level subsided within the apparatus.

The report for this project details the field and laboratory studies that evaluated the effects of pulsed water releases for commercial and recreational purposes on the behavior and movements of subadults and adults of these fish species.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objective:

- **Bringing environmentally safe energy services and products to the marketplace.** By evaluating the potential effects of pulsed flows on fish species downstream of dams, this research provided information to improve fish tracking methods and to help agencies manage their pulsed flows so that their effect on the local fish fauna is minimal.

Results

When the rainbow and brown trout were tracked during the single pulsed flow in the Silver Creek reach of the American River, no significant differences were found between the distances moved after capture, later prior to the pulsed release, during the release, and after the release. The total fish density in each pool did not appear to differ markedly before and after the pulse.

When rainbow trout, hardhead minnows, and Sacramento suckers were placed in artificially pulsed flows within the longitudinal flume, the fish moved upstream or downstream; however, the mean position of the individuals was close to the center of the flume during increasing and decreasing flows. In the test with the lateral displacement flume, only three (7.8%) of the 38 fish placed within the apparatus became stranded within one of the artificial pools.

Final Report

The final report for this project, *Experimental and Field Studies to Assess Pulsed, Water Flow Impacts on the Behavior and Distribution of Fishes in the South Fork of the American River* (CEC-500-2005-172) is posted on the Energy Commission website, at www.energy.ca.gov/2005publications/CEC-500-2005-172/CEC-500-2005-172.PDF.

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